

THE RELATIONSHIP OF SUBDUED GROOVED TERRAIN, MESAS, AND KNOBS IN NORTHERN ELYSIUM PLANITIA, MARS: R.A. De Hon, Department of Geosciences, Northeast Louisiana University, Monroe, LA 71209.

Summary: Polygonally grooved terrain on the northern edge of Elysium lavas grades northward through subdued grooved terrain to knob and mesa terrain and continues to knobby plains. Features within the subdued grooved terrain provide clues to its origin. The transition represents a degradational sequence as erosional plains are formed at the expense large, high-standing lava-capped blocks.

Regional Setting and Physiography: The northern distal margin of the Elysium Mons is marked by polygonally grooved terrain that grades northward over a distance of greater than 250 km to knobby plains. Four distinct bands of terrain can be delineated. These zones include 1) grooved terrain, 2) subdued grooved terrain, 3) knob and mesa terrain, and 4) knobby terrain. What is the relationship, if any, between grooved terrain, mesas, and knobs?

Polygonally grooved terrain occurs at the northern limit of continuous lava flows from Elysium Mons west of the older volcanic construct of Hecates Tholus (Hvg of [1]). This zone is approximately 20 km wide and extends 300 km westward. The zone is characterized by smooth, flat-topped, polygonal blocks, 5 to 10 km across, separated by steep-sided, 0.5-1 km wide, flat-floored, linear grooves. The topography is fresh-appearing with features common to both chaotic terrain and fretted terrain [2, 3]

Grooved terrain passes northward into an approximately 40 km wide belt of *subdued grooved terrain* characterized by large flat-topped blocks separated by shallow, rounded-edge linear grooves. The upper surface of the blocks which is at a slightly lower elevation than the fresh-appearing grooved terrain, is capped by a smooth surface interrupted by clusters of small hills. The polygonal blocks in this terrain are 10 to 20 km across, and intervening grooves are about 1 km wide. The low relief and rounded edges of the topography in this region gives the appearance of degradation of originally sharp terrain similar to that of the grooved terrain [4].

Northward, subdued grooved terrain grades into an approximately 120 km wide belt of *knob and mesa terrain* characterized by isolated, steep-sided mesas, 2 to 5 km across, and knobs, basal diameter 1 to 2.5 km, separated by wide areas of relatively smooth plains. The smooth plains portion of this belt exhibits faint, rounded scarps outlining irregularly shaped, shallow, flat-floored depressions that range from 1.5 to 10 km wide. Sharp-edged mesas and knobs of this zone are located within these depressions. Small-scale, narrow ridges run parallel to the infacing scarp of some depressions. Many of the ridges form septa connecting mesas and knobs.

The belt of knob and mesa topography grades northward into an approximately 400 km wide zone of *knobby plains* [1, 5, 6]. Small, sharply-defined knobs, 0.5 to 1 km basal diameter, are scattered across the surface in seemingly random distribution. Spacing between knobs varies greatly.

Degradation Model: The origin of knobs and mesas represents a conspicuous problem in martian geomorphology. Individual mesas and knobs could be explained by any number of hypotheses as small volcanic constructs, sub-ice volcanoes, pingos, mogotes, or erosional remnants of a plateau surface. In like manner, the small ridges in the region of knob and mesa

terrain resemble small ridges that have been attributed to linear pingos, tombolos, eskers, longitudinal dunes, dikes, and moraines. However, the assemblage of presumably related, juxtaposed features provides some restrictions and possible insights into the origin of the landforms.

The key to interpretation of the various terrains lies in the transitional morphologies of the subdued grooved terrain and the knob and mesa terrain. The grooved terrain is flanked by waterworn and flow-modified surfaces and channels indicating that blocks have formed by removal of support from beneath by decay of permafrost [3, 4, 7]. Grooves are fissures between blocks that have drifted down slope short distances. The subdued grooved terrain is simply a degraded form of the grooved terrain. The surface has been lowered slightly; edges of blocks have been rounded by erosion; and grooves are slightly widened and partially filled in. The knob and mesa terrain is an even more degraded form of the grooved terrain. Grooves have been further widened. Some blocks have been removed completely, leaving faint, wide, polygonal depressions outlining the remaining poorly resolved blocks. Where sharply defined mesas are present, they are located within widened grooves indicating that they are remnants of blocks that have not degraded. Ridges within widened grooves may be remnant septa of detritus washed into narrow grooves.

The transition from large polygons to knobs is not simply progressive burial by thickened plains material. Knobby terrain represents the last remnants of knob and mesa topography in which grooves are widened, subdued blocks are lost, and mesas are reduced to knobs. Presumably knobs, mesas, subdued mesas, and widened grooves are formed by degradation of a permafrost layer [2, 8].

Problems and Unanswered Questions: What is the surficial material? By what process are materials removed so completely? Where does the missing material reside? How are ridges preserved while blocks degrade? Are there terrestrial analogues?

References:

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